BTEC Assignment Brief

Qualification	Pearson BTEC International Level 3 Diploma in Engineering Pearson BTEC International Level 3 Extended Diploma in Engineering
Unit number and title	**Unit 31: Thermodynamic Principles and Practice**
Learning aim(s)	**A:** Investigate thermodynamic principles related to the expansion and compression of gases that are applied in mechanical systems
Assignment title	Investigate thermodynamic principles and polytropic processes
Assessor	
Issue date	
Hand in deadline	
Vocational Scenario or Context	You are a final year apprentice within an engineering organisation which specialises in thermal engineering systems. Your supervisor has been observing your progress and is impressed by your knowledge and understanding of the theory which underpins thermodynamic systems. He has asked you to produce a written report which could be used to introduce the subject to future first year apprentices to provide them with a background into the subject.
Task 1	You are to produce a written report about thermodynamic systems, which: a) explains the fundamental parameters of thermodynamics and thermodynamic process parameters, b) explains the need for different types of temperature scale, and c) evaluates the polytropic processes, explaining the relationships between parameters and what the results from relevant and accurate calculations. **To do this.** Your tutor will provide you with a range of thermodynamic parameters to research and investigate, along with gases to consider when carrying out calculations to an appropriate degree of accuracy and using appropriate units throughout. Your report should contain: • Explanations of the differences between sensible heat, latent heat, including latent heat of fusion and latent heat of vaporisation and relationship between temperature at constant pressure or volume during expansion and/or compression. • Calculations of the values and explanations of the significance of the answers: - Thermal energy of **gas A** - Thermal power of **gas A**. • Explanations for why different temperature scales are needed, and why conversions are carried out between the scales.

	You then need to: • Complete the following calculations, using the data provided for **Gas B**, for three different polytropic processes: 1) A piston contains M1 kg of air at temperature T1 and pressure P1. The air is heated to 1200°K while being kept at a constant volume of 5 litres. Calculate the mass and pressure of the air following heating. Assume the gas constant for air is 287 $Jkg^{-1}K^{-1}$ 2) A cylinder contains a gas at temperature T2 and pressure P2. It is then cooled to 100°C when the pressure is 1.2 MPa. Find the polytropic process index value(n) for the gas 3) A gas is stored in a cylinder that has a volume of V3 litres. The gas is stored at temperature T3 and pressure P3. The gas is then released into the air. Calculate the final temperature of the gas and the polytropic process index value 'n' of the gas. You need to then produce an evaluation of these polytropic processes, explaining the relationships between parameters and what the results of the calculations show in terms of the impact and operation of the thermodynamic system.
Checklist of evidence required	A report will focus on the thermodynamic principles related to both the expansion and compression of gases and an analysis of investigations into the outcomes of polytropic processes.

Criteria covered by this task:	
Unit/Criteria reference	To achieve the criteria you must show that you are able to:
31/A.D1	Evaluate the effects of thermodynamic process parameters on thermodynamic systems, while explaining the need for and correctly converting between different temperature scales and calculating accurately unknown values for a range of given polytropic processes
31/A.M1	Analyse the effects of thermodynamic process parameters on thermodynamic systems, while explaining the need for and correctly converting between different temperature scales.
31/A.M2	Calculate accurately the masses of gases, their final condition parameters and the process index 'n' for a range of given polytropic processes.
31/A.P1	Explain the fundamental parameters of thermodynamics and their relationship with thermodynamic process parameters.
31/A.P2	Explain why different temperature scales are used in engineering applications, using examples to convert between different scales.
31/A.P3	Calculate the masses of gases and their final condition parameters for a range of given polytropic processes.

Sources of information to support you with this Assignment	**Books** Nag, P.K.; Engineering Thermodynamics, 2008, McGraw-Hill, ISBN 9780070260627 Rayner, J.; Basic Engineering Thermodynamics, 1996, Pearson Education, ISBN 9788131718889 Resources may be found at: qualifications.pearson.com/en/support/published-resources.html#step1

Note to assessor:

Scenario

Task 1, 2, 3 etc.

Variables to be used in calculations

Variables for Thermal Energy and Power Calculations

Gas A

Learner	Mass (kg) (m)	Temperature change (ºC) (ΔT)	Heat capacity (J/kgºC (c)	Time (s) (t)
1	0.1	25	1.04	5
2	0.2	20	1.69	10
3	0.3	15	1.93	12
4	0.4	12	1.25	5
5	0.5	35	0.88	10
6	0.2	40	1.05	15
7	0.4	30	5.19	5
8	0.6	25	2.22	10
9	0.4	12	1.25	15
10	0.3	12	0.88	10

Variables for Polytropic Process Calculations

Gas B

Learner	M1 (kg)	T1 (ºC)	P1 (kPa)	T2 (ºF)	P2 (MPa)	V3 (l)	T3 (K)	P3 (MPa)
1	0.1	525	150	250	2	5	300	4
2	0.25	620	140	240	1.9	4.5	310	3.8
3	0.2	715	130	230	1.8	4	320	3.6
4	0.15	510	160	320	1.7	3.5	330	3.4
5	0.4	635	170	350	1.6	3	340	3.2
6	0.35	740	200	340	2	2.5	350	3
7	0.3	630	190	330	1.9	2	360	2.8
8	0.5	625	180	320	1.8	1.5	370	2.6
9	0.05	710	120	310	1.7	1	380	2.4
10	0.35	700	100	300	1.6	0.5	390	2.2